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Engineering Bulletin

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E&AM Civil - Civil Structures

Metrolinx Civil Structures Bulletin 03

Amendment Notice: Structural Requirements for LRT and Subway Projects

This Bulletin applies to and amends the following sections of the TTC Design Manual, which have been adopted by Metrolinx as structural requirements applicable to the design and construction of LRT and Subway elevated guideways and bridges, underground structures, retaining walls, portals, and culverts:

TTC Design Manual

- DM-0301-01 General - Limit States Design
- DM-0301-02 General - Design Loads
- DM-0301-03 General - Design Load Combinations
- DM-0302-01 Underground Structures - Design Loads
- DM-0302-02 Underground Structures - Construction Methods
- DM-0302-03 Underground Structures - Box Structures
- DM-0302-04 Underground Structures - Tunnelled Structures
- DM-0302-05 Underground Structures - Miscellaneous Structures
- DM-0303-01 Elevated Structures - General Considerations
- DM-0303-02 Elevated Structures - Design Loads
- DM-0303-03 Elevated Structures - Special Design Considerations
- DM-0304-01 Concrete – General
- DM-0305-01 Structural Steel – General
- DM-0306-01 Prestressed Concrete – General

Notes:

1. Where the documents listed above refer to TTC or the Commission for consultation, information, review and/or approvals, Metrolinx shall replace TTC or the Commission as the approving authority and the project teams shall follow Metrolinx review and approval procedures.

2. Where the documents listed above refer to other sections of the TTC DM, the applicability of the referenced sections is subject to further confirmation by Metrolinx. The project team is responsible for obtaining such confirmation before applying the referenced requirements.

3. Where the documents listed above refer to other codes or standards, the applicable version of the reference shall comply with the Project Agreement or the latest at the time of design.

Amendments to the TTC Design Manual are provided in the following attachment:

- Metrolinx Civil Structures Bulletin 03: Structural Requirements for LRT and Subway Projects

The Bulletin is available for internal and external users to download via the Metrolinx public download site (www.gosite.ca/engineering_public/CivilStructures).

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REFER TO DM-0301-01GENERAL - LIMIT STATE DESIGN | Section 3 SERVICEABILITY AND FATIGUE LIMIT STATES

1. In addition to requirements of sub-section 3.5, all complex and significant (C&S) structures shall be designed for a minimum of 100-year service life, or longer when justified by Life Cycle Cost Analysis. C&S structures shall be listed in the Project Agreement/PSOS documents, subject to review and acceptance by Metrolinx Civil Structures – Engineering. The durability and fatigue requirements in DM-0303-03 shall be adjusted accordingly. C&S structures include, but are not limited to:

   a) Single-span bridges of span greater than 60m;
   b) Multi-span bridges of span(s) greater than 60m or where the overall length of the bridge is more than 250m;
   c) Bridges which cannot be analyzed by the Simplified Method of Analysis as per CAN/CSA - S6, Section 5 and that need to be analyzed using refined methods of analysis;
   d) Curved bridges that exceed the criteria of CAN/CSA-S6 A5.1 where dead and live loads twisting moments and associated effects of torsional and distortional wrapping need to be considered;
   e) Bridges with complex boundary conditions, articulation and idealization;
   f) Tunnels; and
   g) Bridges built in locations with complex Foundation conditions.

   The structural design of all C&S structures shall be independently checked by a structural engineer other than the engineer who completed the design.

DM-0301-02 GENERAL - DESIGN LOADS |SECTION 3.2 TRANSITORY AND EXCEPTIONAL LOADS (L) DUE TO USE AND OCCUPANCY

1. Vehicle loads specified in sub-sections 3.2.1-3.2.10 are for reference only; design live load shall be based on project-specific vehicle configuration as approved by Metrolinx.

DM-0302-04 UNDERGROUND STRUCTURES – TUNNELLED STRUCTURES

1. In addition, refer to METROLINX Tunnels and Underground Structures Interim Standard MX-TUS-STD-001 for further requirements related to tunnelled structures.

DM-0303-02 ELEVATED STRUCTURES – DESIGN LOADS |SECTION 4.1 WIND LOAD (W)

1. The reference wind pressure, q, as shown in this section is for Toronto only; for projects located outside Toronto, q shall be in accordance with CSA S6 (latest) climatic and environmental data - Reference Wind Pressure.

DM-0303-02 ELEVATED STRUCTURES – DESIGN LOADS |SECTION 4.3 EARTHQUAKE LOAD (Q)

1. This section is deleted in its entirety. Earthquake load and seismic design shall be in accordance with CSA S6 (latest) - Seismic Design. Guideway structures, bridges and elevated platforms shall be designed for seismic effects as lifeline bridges unless otherwise approved by Metrolinx.

DM-0303-02 ELEVATED STRUCTURES – DESIGN LOADS |SECTION 6.2.1 TEMPERATURE RANGE

1. Maximum and minimum daily temperatures as shown in this section are for Toronto only; for projects located outside Toronto, the temperature range shall be in accordance with CSA S6 (latest) – Temperature effects.

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DM-0303-03 ELEVATED STRUCTURES – SPECIAL DESIGN CONSIDERATION |SECTION 3. DEFLECTION AND CONTROL OF VIBRATION EFFECTS

1. In addition to the requirements in this section, if higher or additional serviceability design criteria are deemed necessary by the Structural Engineer to meet project-specific requirements, such as higher vehicle speeds or enhanced ride quality, the requirements in this section shall be adjusted accordingly.

DM-0304-01 CONCRETE – GENERAL |SECTION 3.1 MATERIALS - CONCRETE

1. As an exception to the requirements of sub-section3.1.2, the specified compressive concrete strength may exceed 40 MPa at 28 days, as follows (per MTO Structural Manual):

28-day compressive strength	Applications
45 MPa	Precast concrete culverts with spans greater than 3 m
50 MPa	Precast prestressed box beams
60 MPa	Precast prestressed NU girders

DM-0304-01 CONCRETE – GENERAL |SECTION 3.2 REINFORCING STEEL

1. In addition to the requirements of sub-section 3.2.6, for bridge components within salt susceptible areas, refer to MTO Structural Manual (latest) Section 2.4.8 Corrosion Protection Policy for Concrete Bridge Components and Section 12.2 Premium Reinforcing – where required for corrosion protection and premium reinforcing requirements.

DM-0304-01 CONCRETE – GENERAL |SECTION 6.4 WATERSTOP

1. Sub-section 6.4.3 is deleted and replaced with continuous waterproofing shall be provided around underground structures in addition to meeting all requirements of TTC-DM-0410-02.

DM-0305-01 STRUCTURAL STEEL |Section 3.1 MATERIALS – STRUCTURAL STEEL

1. For hollow steel sections (HSS), in addition to Grade 350 W Class H, as specified in sub-section 3.1.2, Grade 350 W Class C may be used if meeting all design requirements and approved by the Design Engineer.

DM-0305-01 STRUCTURAL STEEL |SECTION 3.2 ANCHOR BOLTS

1. The reference to ASTM A307 in this section is superseded by reference to CSA G40.20/G40.21 or ASTM F1554.

DM-0306-01 PRESTRESSED CONCRETE – GENERAL |SECTION 3.1 MATERIALS - CONCRETE

1. Refer to DM-0304-01 CONCRETE – General |Section 3.1 above.